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ABSTRACT

The Position Analysis Questionnaire (PAQ), a structured job analysis questionnaire that provides for the analysis of individual jobs in terms of each of 187 job elements, was used to establish the job component validity of certain commercially-available vocational aptitude tests. Prior to the general analyses reported here, a statistical analysis was carried out with the attribute profile data of the General Aptitude Test Battery (GATB) of the U.S. Employment Service as the possible basis for the prediction of aptitude requirement of jobs. In addition, a cluster analysis was carried out using a hierarchical grouping technique as applied to scores on 13 "overall" dimensions of the PAQ. The final analyses consisted of using as a sample jobs for which test data and PAQ analyses were available. A separate analysis was carried out for each of five of the constructs represented by the GATB tests. These included general intelligence, verbal aptitude, numerical aptitude, spatial aptitude, and clerical perception. Results of the analyses generally supported the potential use of a structured job analysis procedure such as represented by the PAQ as the basis for the establishment of aptitude requriements for jobs for at least certain aptitudes. (Author/HV)

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THE USE OF THE POSITION ANALYSIS QUESTIONNAIRE (PAQ) FOR ESTABLISHING THE JOB COMPONENT VALIDITY OF TESTS

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Over the years there have been speculations and discussions about the possibility of some type of "generalized" approach to the establishment of the validity of personnel tests, in order to preclude the need for validation of tests in individual circumstances. In some instances it is simply not possible to carry out conventional test validation procedures, such as in cases where there are too few people on a particular job for an adequate study, or if no appropriate criterion is available.

There have been a few studies that have dealt with procedures for the development of some generalized approach, perhaps the most expansive studies having involved the use of the Position Analysis Questionnaire (PAQ). The PAQ is a structured job analysis questionnaire that provides for the analysis of individual jobs in terms of each of 187 job elements. On the basis of a series of principal components analyses of PAQ data a number of "job dimensions" have been identified. Scores for jobs on these job dimensions have been used as the basis for the prediction of test-related criterion values of incumbents on jobs, these studies employing data from the nine tests of the General Aptitude Test Battery (GATB) of the United States Employment Service. In certain other studies the "attribute profiles" of the job elements of the PAQ have been used in conjunction with the PAQ analyses of jobs as the predictors of the test-related criterion values. (The attribute profiles consist of the median ratings on 71 attributes as rated in terms of their relevance to the individual job elements of the PAQ.)

The use of PAQ job dimension scores and the attribute profile data have indicated substantial potential for the use of a structured job analysis procedure (such as the PAQ) for deriving reasonably valid estimates of aptitude requirements of jobs. This generalized approach has been referred to as job component validity.

The current research program is directed toward the further testing of the use of the PAQ for the purpose of establishing the job component validity of tests, except that it was directed toward the prediction of test-related criterion values based on commercially-available tests, as contrasted with those studies based on the GATB tests (which are not available for use by private organizations).

As preliminaries to the general analyses involved in this project, a special analysis was carried out with the attribute profile data as the possible basis for the prediction of aptitude requirements of jobs, involving various methods for the statistical utilization of such data. In addition, a cluster analysis was carried out using a hierarchical grouping technique as applied to scores on 13 "overall" dimensions of the PAQ.

The final analyses consisted of using as a sample jobs for which test data and PAQ analyses were available. A separate analysis was carried out for each of five of the "constructs" represented by the GATB tests, the jobs included in each analysis being those for which test data were available for incumbents, and for which PAQ analyses were available. In these analyses, a comparison was made of the predictibility of the test-related criterion values for incumbents as based on the use of job dimension scores for individual PAQ analyses, as contrasted with the predictibility of the test-related criterion values for jobs which had been grouped into job families using the mean job dimension scores for all of the jobs in each of the job families. Individual jobs were then allocated to the job families with which they were most nearly matched (using a D^2 index). The predicted criterion values for the job families were then "applied" to the individual job "assigned" to them, and were then used in the prediction of the actual test-related criterion values.

The results of the analyses generally supported the potential use of a structured job analysis procedure such as represented by the PAQ as the basis for the establishment of aptitude requirements for jobs for at least certain aptitudes, thus generally lending substantial support to the practical use of such a procedure for establishing the job component validity of jobs.

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INTRODUCTION

Over the years various arguments have been set forth for the development and use of some generalized approach to the establishment of personnel requirements for jobs. These suggestions have been referred to as generalized test validity, or synthetic test validity. The primary arguments for such an approach have fallen into two general groups. In the first place, on rational grounds it would seem that those jobs which have certain human behaviors in common should also require the same kinds of human attributes in so far as those common behaviors are concerned. The second type of argument has generally been centered around practical considerations. Often it is impossible to validate tests in each and every job situation, and in any event the time and cost of doing so are prohibitive.

The basic approach that would seem to be common to any such effort logically would be predicated upon the following: (1) for various jobs some method of identifying the constituent components of those jobs which possibly have behavior requirements in common; (2) a method of determining, for an experimental sample of jobs, the human attribute(s) required for successful performance as related to each of those job components; and (3) some method of combining the estimates of human attributes required for individual job components into an overall estimate of human attributes requirements for an entire job. Such a procedure would make it possible to "build-up" the attribute requirements for any given job by: (1) knowing what job components occur in the job in question; (2) knowing the attribute(s) required for each such component; and (3) having a procedure for measuring the attributes that are relevant to the individual job components. Because of the dependence of such procedures on the identification of various types of relevant job characteristics, it would seem that the term "job componenent validity" could well apply to such a procedure.

There have been a few individual studies directed toward the establishment of the aptitude requirements of jobs on the basis of some such generalized approach. Most of these studies have dealt with jobs within a certain restricted area. Perhaps the most generalized approach to this has involved the use of the Position Analysis Questionnaire (PAQ) (McCormick, Jeanneret, and Mecham, 1972).

The Position Analysis Questionnaire (PAQ)

The Position Analysis Questionnaire is a structured job analysis questionnaire that provides for the analysis of a variety of jobs in terms of each of 187 job elements. The job elements are classified in the following six divisions. In each instance, an example of a job element is included.

PAQ Division	Illustrative Job Element
1. Information Input	Use of Written Materials
2. Mental Processes	Coding/Decoding
3. Work Output	Use of Keyboard Devices
4. Relationships With Other Persons	Interviewing
5. Job Context	Noise Intensity
6. Other Job Characteristics	Responsibility of Safety for Others

In the analysis of jobs with the PAQ, various rating scales are used with the different job elements such as: Importance to the Job; Amount of Time; Possibility of Occurrence (as in the case of accidents); Extent of Use; Applicability (whether the job element does or does not apply); and Special rating scales.

Job Dimensions Based on the PAQ

Various principal components analyses have been carried out with PAQ-based data in order to identify the principal components that characterize the structure of jobs (McCormick, Jeanneret and Mecham, 1969; Marquardt and McCormick, June 1974). The most recent of these is based on a reasonably representative sample of 2200 jobs (Mecham, February 1977). His analyses included separate principal components analyses of the job elements within each of the six divisions, and an "overall" analysis based on all the job elements (with a few exceptions). These analyses resulted in 32 "division" dimensions and 13 "overall" job dimensions.

PREVIOUS RESEARCH WITH THE PAQ

The primary previous research with the PAQ in the job component validity frame of reference was carried out with jobs for which test data for job incumbents were available through the United States Employment Service. (Mecham and McCormick, 1969; and Marquardt and McCormick, July 1974). In these studies two criteria were used as indexes of the "importance" of the attributes measured by the General Aptitude Test Battery (GATB) to the individual jobs in a sample of jobs. One of these consisted of the mean test scores of incumbents on the various job, and the other consisted of the validity coefficients. In these studies separate analyses were carried out for each of the nine tests of the GATB. In the first of these studies PAQ analyses for 179 positions were "matched" with 90 jobs for which the USES had published test data for the job incumbents. (There were multiple analyses for certain jobs.) In the second study PAQ analyses for a total of 659 positions were matched with 149 jobs for which the USES had published test data. In the case of both of these studies the prediction of the mean test scores of the incumbents from PAQ job dimension scores was quite respectable. However, the prediction of the validity coefficient criterion was not as good, perhaps at least partially because of the well-recognized problems associated with validity coefficients, such as poor criteria, restricted range, etc.

In the third analysis of this type carried out by Mecham (April 1977), data relating to the PAQ analyses were matched with 163 jobs for which the USES had published test data. In this study, however, instead of matching individual PAQ analyses with these jobs, all of the PAQ analyses that had the same 9-digit code number from the Dictionary of Occupational Titles (DOT) were "averaged" to represent a "single" PAQ analyses to be matched with each of the 163 jobs for which the GATB test data were available. This procedure was used since it was felt that the "average" PAQ job dimension scores for various jobs with the same DOT code number would represent more stable values for the jobs than PAQ analyses of individual positions.

In the studies by Mecham (April 1977) and Marquardt (July 1974) a third criterion of the "importance" of various tests to the jobs in question was used. This criterion was the value one standard deviation below the mean test scores of the incumbents on the individual jobs. This criterion is called "1 SD below the mean," or "mean-SD." Such a value might be viewed as a possible cutoff score. Although test cutoff scores used in personnel selection obviously vary with labor market conditions, it is probable that, in general terms, scores one standard deviation below the means would more nearly approximate typical cutoff scores than mean scores as such.

The ranges and medians of the multiple correlations across the nine GATB tests resulting from these three studies are given below:

Criterion		Mecham and McCormick	Marquardt and McCormick	Mecham
Mean test scores				
	Range	.59 to .80	.46 to .76	.30 to .83
	Median	.71	.73	.73
1 SD below the mean				
	Range		.42 to .77	.24 to .84
	Median		.73	.70
Validity coefficients				
	Range	.40 to .59	.26 to .44	-.02 to .39
	Median	.47	.39	.13

Another approach to the use of PAQ-based data as the basis for estimation of aptitude requirements for jobs involves the use of what are referred to as "attribute profiles" of the job elements of the PAQ. These attribute profiles consist of the median ratings of the "relevance" of each of 71 human attributes to each of the job elements. The ratings were carried out by industrial psychologists, there being at least eight ratings for each of the attributes. (Mecham and McCormick, 1969; Marquardt and McCormick, 1972). In a subsequent study (Shaw and McCormick, 1976) several methods of combining the attribute profile data and the job analysis data for individual jobs were used experimentaly as the basis for prediction of test-related criteria. In these various studies, the use of the attribute profile data was reasonably effective in the prediction of mean test-score criteria of job incumbents on the

cognitive tests, was moderately predictive of the test data for the perceptual tests, but was not effective with the psychmotor tests (such as motor coordination, finger dexterity, and manual dexterity).

OBJECTIVES OF THE PRESENT RESEARCH PROJECT

As indicated above, the previous research with the PAQ in the job component validity framework had involved the use of PAQ-based data for the prediction of test-related criterion data for incumbents on the nine GATB tests. Since these tests are not available for use by private organizations, it was considered desirable to experiment with the use of the PAQ as the basis for the establishment of job requirements expressed in terms of commercially-available tests. The basic approach used in the present project was substantially the same as that used in previous research in which GATB test data were used, except that in the present instance test data for job incumbents based on commercially-available tests were used.

METHOD

The objectives of the study required the accumulation of test data for incumbents on various jobs, along with PAQ analyses for each such job. In this regard, efforts were made to obtain test validity and/or normative data from various kinds of organizations, for virtually any type of job, and involving virtually any commercially-available aptitude test, or tests that resembled commercially-available tests. Various types of appeals were made to many different organizations. (These approaches are discussed further in McCormick, DeNisi, and Shaw, May 1977). It must be stated that the results of these several appeals were very discouraging, resulting in the accumulation of appropriate test-related data for incuments on only 202 jobs. In certain instances these test data were obtained from published sources.

In the case of some jobs for which test data were available, it was not possible to obtain PAQ analyses of the jobs in question, and in some of these instances PAQ analyses for corresponding jobs were obtained from the PAQ data bank (which at the time included analyses of about 25,000 positions, representing 1900 different job classifications).

Constructs Used In The Study

The basic approach of the project involved the development and use of regression equations consisting of PAQ job dimension scores as predictors of test-related criteria based on the GATB tests. Therefore, in considering the test data that had been obtained for incuments on various jobs, it was the intent to select test data that were based on tests that measured the same "constructs" as those measured by the nine GATB tests. In this way it presumably would be possible to use the same regression equations derived for the GATB tests in the prediction of test-related criteria for corresponding commercially-available tests. The "matching" of commercially-available tests with GATB tests was based largely on subjective judgments of similarity of content of the tests. Only in certain instances were data available on the correlations between

the commercially-available tests and the GATB tests.

Conversion of Norms

Since data for one or more commercially-available tests were to be used as measures of each of the "constructs" represented by the GATB tests, it was necessary to convert scores of the individual tests to a common metric. For this purpose a standard score system was used that consisted of a mean of 100 and a standard deviation of 20. (This is the same standard score system as used with the GATB tests.) The GATB tests norms are based on a "general working population." In the case of the commercially-available tests there were very few norms based on such populations, and therefore it was necessary to "build up" such a general norm for each test from combinations of norms for various subgroups. This method of forming a "general working population" norm for any given test undoubtedly introduced some error into the common normative metric. Unfortunately there was no other acceptable alternative available. This conversion was necessary for two of the four criteria of the "importance" of individual constructs to the jobs in question.

Actual Criteria Used

Four criteria were used in the study, these different criteria representing various indices of the "importance" of each of the constructs represented by the GATB tests to the jobs in the sample. These criteria for each job and test consisted of: (1) the mean test score of job incumbents on the individual job; (2) the test score one standard deviation below the mean of the scores of incumbents on each job, referred to as "1 SD below the mean" or "mean-SD;" (3) a validity coefficient; and (4) an indication of whether the test would be "valid" for the job. (A test was considered to be "valid" if the data obtained on that test included a statistically significant validity coefficient. If a validity coefficient was reported for a job but was not statistically significant, then the test was considered to be "nonvalid." If no validity coefficient was reported this criterion was of course considered as "missing" for the particular job in question). The primary criteria of the project were considered to be the mean test scores and the scores one standard deviation below the mean (1 SD below the mean).

Predicted Criterion Values

The predicted criterion values for the individual jobs were obtained from standard computer printouts of data that are generated from the PAQ analyses of jobs. The first three predicted criteria are based on the regression equations derived from the analysis of the PAQ job dimension scores as predictors of those criteria as based on the GATB tests. The fourth criterion (an indication of whether the test would or would not be "valid" for the job) reflects essentially a "policy capturing" procedure that parallels the practice of the USES in its approach to the identification of the three "best" or most "valid" tests for use in the selection of individuals for any given job. A test was predicted to be "valid" if it were one of the three tests identified as being "best" in terms of the USES procedures. A

test would be predicted to be "nonvalid" if it were not one of these three "best" tests.

Cluster Analysis of Jobs

It was planned to carry out the analyses of the use of PAQ-based data for the estimation of aptitude requirements of jobs on the basis of PAQ analyses of individual jobs, and also on the basis of the placement of individual jobs into job families or clusters.

Toward this end it was then necessary to have a set of job clusters (or job families) that could be used in this phase of the analysis. In an earlier study DeNisi and McCormick (1974) had carried out two cluster analyses of jobs as based on PAQ data. Although those cluster analyses had been carried out with PAQ-based data, they had involved the use of an earlier set of job dimensions. Since the current study involved the set of jobs dimensions developed by Mecham (February 1977) it was considered desirable to use these as the basis for a cluster analysis. In this regard, Mecham's 13 "overall" dimensions were used. The sample of jobs consisted of 746 jobs that was a sub-sample of 2200 jobs which had earlier been used in the principal components analysis of PAQ data for the derivation of the job dimensions. The job dimension scores on these 13 dimensions for the 746 jobs were subjected to a hierarchical grouping procedure developed by Ward (1961) and Ward and Hook (1963).

In the formation of job families (i.e., clusters) a major problem lies in making a decision regarding the number of families to recognize. The more clusters, the more homogeneous the jobs within the clusters. But greater homogeneity must be made at the possible sacrifice of practical considerations, since, for practical considerations, fewer clusters usually would be desirable. For purposes of this study a decision was made to use three sets of clusters, each set consisting of different numbers of clusters, in order to be able to compare the predictability of the criterion values when the predictors were based on various numbers of clusters to which jobs were assigned. Toward this end, the three sets of clusters chosen were those emerging from the iterations that resulted in 60, 40, and 20 clusters. These clusters are illustrated in the report by Shaw, DeNisi and McCormick (April 1977).

General Plan of Analyses

In very general terms the analyses that were carried out can be characterized in terms of the following combination of variables: the use of PAQ analyses of individual jobs vs. PAQ analyses of job families as the basis for prediction; the types of predictors that were used; and the criteria that were used. The various combinations of these variables are shown below:

Basis of Prediction

	Individual jobs		Job families	
Criterion	Job dimension scores	Attribute data	Job dimension scores	Attribute data
Mean	X	X	X	
"1 SD below mean"	X	X	X	Not relevant
Validity	X	—	X	
Valid-nonvalid	X	—	—	

An "X" indicates those specific analyses that were carried out.

This plan was repeated for the constructs represented by each of five of the GATB tests, namely: G (General Intelligence); V (Verbal Aptitude); N (Numerical Aptitude); S (Spatial Aptitude); and Q (Clerical Percpetion).

There were insufficient jobs for which relevant data were available to carry out analyses for the other four constructs, namely: P (Form Perception); K (Motor Coordination); F (Finger Dexterity); and M (Manual Dexterity).

Two types of PAQ predictors were used, namely those which consisted of job dimension scores, and those which were derived from the "attribute profiles" of the PAQ job elements. These two types were used with the "individual" PAQ analyses, but only those based on job dimension scores were used with the "job family" PAQ analyses.

In connection with the job families, the average scores of all of the jobs within each family were derived for the various job dimensions. These "average" scores were then used as the basis for predicting criterion values, just as in the case of PAQ analyses of individual jobs. In turn, these predicted criterion values were applied to all of the individual jobs that fell within the various job families.

RESULTS

Separate analyses were conducted on the predictions based on the job dimension scores for the individual PAQs and for each set of clusters as well as on the attribute data. In each case, Pearson product-moment correlations were computed between the predicted and the actual test-related measures for the four criteria.

The analyses based on the job dimension scores were originally conducted for the total sample of 202 jobs. As had been the case in past research, predictions relative to the mean test scores and the scores 1 SD below the mean were quite good, but the predictions relative to the validity coefficients and the "valid-nonvalid" criterion were somewhat disappointing. The results for the total sample will not be reported here, however, because of certain problems that were found to be associated with certain of these data. (The results for the total sample are reported by McCormick, DeNisi, and Shaw, May 1977.)

The first problem stemmed from the fact that a large portion of the sample (79 jobs) came from one company, hereafter designated as "Company X." The test data from this company were all based on "special" or in-house tests developed by the company, which it was feared might be qualitatively different from the other tests used to measure the different constructs. Furthermore the test data from this company from the 79 jobs were consolidated into seven job families, and it was not possible to sort out those for the 79 individual jobs. The actual test data, then, were available for only these seven job families, but the PAQ-based predictions were made for the 79 individual jobs. Each individual job had to be classified into its appropriate job family and the test data for the job family were then used as the criterion data for every job in that family. It was felt that this procedure may have allowed too much "slippage" and might tend to reduce any correlation between predicted and obtained criterion data by restricting the range on the obtained test data. It was therefore decided that eliminating the data from Company X would result in a "cleaner" analysis, thus providing a truer picture of the predictive ability of the PAQ data.

The other problem, however, was not solved by this reduction of the sample. The problem was simply that there were a number of jobs for which actual data were available on mean test scores, but not on scores 1 SD below the mean. Therefore, although these two criterion indices are closely linked, the initial analyses for these two criteria were conducted on samples that overlapped each other, but that were not identical. Thus some differences between the results from these two criteria might be due to the differences in the samples. To eliminate this second problem it was decided to further reduce the sample by including in the analyses pertaining to the mean test scores and the scores 1 SD below the mean, only those jobs for which data were available on both criteria. The results that will be reported, therefore, are those from the analyses conducted on this reduced and matched sample. This sample included 93 jobs. These results are presented in Table 1.

Table 1

Correlations Between Predicted and Actual Test-Related Criteria for Five Constructs: Reduced and Matched Sample

Criterion and Construct	Individual PAQs	Cluster-based Predictions 20 Clusters	40 Clusters	60 Clusters	N
Mean Test Scores					
General Intelligence	.74***	.52**	.43**	.52**	33
Verbal Aptitude	.71***	.65***	.67***	.60***	50
Numerical Aptitude	.67***	.52***	.61***	.56***	64
Spatial Aptitude	.74***	.44*	.50**	.47*	26
Clerical Perception	.53*	.44	.37	.37	15
Average	.66	.52	.53	.51	
1 SD Below Mean					
General Intelligence	.66***	.63***	.49**	.53***	33
Verbal Aptitude	.71***	.62***	.68***	.60***	50
Numerical Aptitude	.63***	.47***	.59***	.55***	64
Spatial Aptitude	.76***	.47*	.51**	.50**	26
Clerical Perception	.60**	.42	.44	.39	15
Average	.68	.53	.55	.52	
Validity Coefficients					
General Intelligence	-.54	.37	-.14	-.14	13
Verbal Aptitude	.30	.53***	.58***	.28	36
Numerical Aptitude	.25*	.12	.48***	.40***	76
Spatial Aptitude	.26	.29	.25	.35*	43
Clerical Perception	-.02	-.03	.16	.32*	29
Valid-Nonvalid		[1]			
General Intelligence	.17	—	—	—	13
Verbal Aptitude	-.18	—	—	—	36
Numerical Aptitude	.19	—	—	—	76
Spatial Aptitude	.76***	—	—	—	43
Clerical Perception	.51**	—	—	—	29

[1] Analyses for cluster based predictions of valid-nonvalid criterion were not carried out.

*Significant, $p < .05$
**Significant, $p < .01$
***Significant, $p < .001$

As can be seen in Table 1, the predictions of mean test scores and scores 1 SD below the mean were rather successful for the data based on both individual PAQs and the data based on the clusters. Looking first at the prediction of mean test scores, we see that all five correlations for the individual PAQs are significant (four of them at the .001 level) and that they range from .53 (Clerical Perception) to .74 (General Intelligence and Spatial Aptitude) the average correlation for the five constructs being .66. The results for the cluster-based predictions are also quite respectable. However, these correlations are generally a bit lower than for the individual PAQs, and in the case of all three sets of cluster-based predictions the correlations for Clerical Perception failed to reach significance. Nevertheless, the average correlations for the predictions based on 20, 40 and 60 clusters are .52, .53, and .51 respectively; all are indicative of fairly strong relationships between predicted and obtained data.

Looking at the scores 1 SD below the mean, we find the same general pattern of results. Again, all five correlations for the individual PAQs are significant (four at the .001 level), the range being from .60 (Clerical Perception) to .76 (Spatial Aptitude), with the average correlation being .68. Again, the cluster-based predictions are also fairly strong, although the correlations are somewhat lower here than for the individual PAQs and, once again, none of the correlations for Clerical Perception is significant. The average correlations for the predictions based on the 20, 40 and 69 clusters are .53, .55 and .52 respectively; slightly better than for the mean test scores

As can be seen in Table 1, however, the results for the validity coefficients and the valid-nonvalid criterion are rather disappointing, especially for the individual PAQs. The correlations for the individual PAQs predicting validity coefficients range from -.54 (General Intelligence) to .30 (Verbal Aptitude) with only one significant correlation. Looking at the results for the valid-nonvalid criterion, we see they are a bit better, the range being from -.18 (Verbal Aptitude) to .76 (Spatial Aptitude), with two of the correlations being significant for the individual PAQs. Although no analyses were conducted with the valid-nonvalid criterion for the cluster based predictions, it is interesting to look at the cluster results for the validity coefficients. The results for the 20, 40 and 60 clusters are generally better than for the individual PAQs. One would expect the results based on the individual PAQs to be superior to those based on the clusters since the cluster-based analyses provide for the predictions for all of the individual jobs within a given cluster to be the same, whereas the actual criterion data are different for the individual jobs. However, since PAQ-based data have never been shown to be very successful in predicting validity data, it may be that much of the variance in prediction is due to error variance, and that by averaging these predictions for a whole cluster one is simply eliminating some of that error variance.

Before moving to the predictions based on the attribute data, one further point should be made. Looking at the results in Table 1, we notice that the results obtained for the three different sets of cluster-based predictions are substantially the same. This is interesting

because one would expect that by increasing the number of clusters to 60, the resulting cluster predictions would more nearly approximate the predictions for the individual PAQs. Conversely, one might expect that the predictions based on 20 clusters (in which the jobs in each cluster are more heterogeneous than in the case of 40 or 60 clusters) would be somewhat lower because of greater possible variability in the jobs within the individual clusters. It is true that the individual PAQs generally do better than the cluster-based predictions, but when considering only the cluster data, we see that the three sets of cluster-based predictions do not differ substantially from one another.

In the past there has been a great deal of concern with how one can determine the optimal number of clusters to use from an iterative grouping procedure such as the one used here. These results indicate, however, that at least for use in a job component validity model, this may not be a crucial consideration. Further research is needed, of couse, but these findings indicate that a researcher may be able to rely more on practical considerations in choosing the optimal cluster solution for use in a job component validity model.

Finally, turning to the predictions based on the attribute data, Table 2 presents the results of the predictions for selected attributes of the different constructs for the criteria of mean test scores and scores 1 SD below the mean. The results presented here are based on the complete sample of 202, since the inconsistency of the results did not seem to warrant further analyses with a reduced and/or "matched" sample. As can be seen in Table 2, althought the predictions based on a few of the attributes are quite respectable (especially in predicting mean test scores for Clerical Perception), others are quite poor (especially in predicting either criterion index for Spatial Aptitude). The inconsistencies in the results case some doubt on the utility of attribute data in a job component validity model. However, the fact that some attribute predictions were quite good might suggest that further research could be useful in identifying the particular circumstances in which attribute data might be a useful basis for predicting test requirements.

Table 2

Correlations Between Selected Attribute Data and Criterion Data for the Total Sample

Criterion and Construct	Attribute	Correlation	N
Mean Test Scores			
General Intelligence	Intelligence	-.07	111
Verbal Aptitude	Verbal Comprehension	.42**	50
Verbal Aptitude	Work Fluency	.43***	50
Verbal Aptitude	Oral Communication	.43**	50
Numerical Aptitude	Numerical Computation	.33***	163
Numerical Aptitude	Arithmetic Reasoning	-.31***	163
Spatial Aptitude	Visual Perception	-.31***	125
Spatial Aptitude	Spatial Visualization	-.32***	125
Spatial Aptitude	Spatial Orientation	.32***	125
Clerical Perception	Verbal Comprehension	.63***	38
Clerical Perception	Arithmetic Reasoning	.62***	38
Clerical Perception	Closure	.56***	38
Clerical Perception	Visual Perception	.42**	38
1 SD Below Mean			
General Intelligence	Intelligence	.01	110
Verbal Aptitude	Verbal Comprehension	.43**	50
Verbal Aptitude	Work Fluency	.46***	50
Verbal Aptitude	Oral Communication	.44**	50
Numerical Aptitude	Numerical Computation	.26**	141
Numerical Aptitude	Arithmetic Reasoning	.23**	141
Spatial Aptitude	Visual Perception	-.27**	103
Spatial Aptitude	Spatial Visualization	-.32***	103
Spatial Aptitude	Spatial Orientation	-.28**	103
Clerical Perception	Verbal Comprehension	.51	15
Clerical Perception	Arithmetic Reasoning	.36	15
Clerical Perception	Closure	.16	15
Clerical Perception	Visual Perception	-.06	15

*Significant, $p < .05$
**Significant, $p < .01$
***Significant, $p < .001$

CONCLUSIONS

On the basis of the results of this study the following conclusions seem to be warranted regarding the use of data from the Position Analysis Questionnaire (PAQ) in the job component validity model as the basis for establishing aptitude requirements for use in personnel selection.

1. Such a model can serve to identify the aptitude tests that have substantial validity for use in personnel selection. This is done on the basis of statistical analyses of data from PAQ analyses of individual jobs. This conclusion is supported particularly by the findings regarding the predictability of mean test scores of job incumbents on various jobs, and the scores of job incumbents one standard deviation below the mean. This is especially true when using a reduced and "matched" sample which was probably the most representative sample available. Such predictions, originally based on test data for incumbents on the nine tests of the General Aptitude Test Battery (GATB) of the United States Employment Service, also hold up quite well with test data from various commercial tests that were considered to measure the same constructs as those measured by the GATB tests. (This analysis was based on five of the nine constructs.) Results of the predictions based on commercial tests resulting from this study are further supported by a recent study by Cunningham et al. (1976) in which the Differential Aptitude Tests were used in much the same fashion.

2. The predictions of the validity-related criteria (those consisting of validity coefficients and those based on a "valid-nonvalid" determination) were generally not very satisfactory. These results are generally consistent with certain previous studies in which the prediction of validity coefficients also was rather poor.

3. Predictions of mean test scores and scores one standard deviation below the mean that are based on job families (formed from PAQ data) are a bit lower than those based on PAQs for individual jobs. They are, however, of such magnitude as to warrant further possible research in the job component validity model. The predictions of the criterion of validity coefficients based on job family data actually tended to be slightly better than the predictions based on PAQ analyses of individual jobs.

4. Predictions based on job families resulting from the 20, 40, and 60 cluster solutions were virtually identical to each other. This is interesting since one of the problems that has often been discussed relative to the use of hierarchical grouping procedures has been the decision regarding the "optimal" cluster solution. The results from this study suggest that the number of job families used in the job component validity model may not be critical, although further research is clearly needed in this area.

5. In connection with the criteria of mean test scores and the scores one standard deviation below the mean, predictions of the test-related criteria from the attribute data are not nearly as consistent as those from the job dimension scores based on PAQ analyses. Although the predictions from the attribute data were reasonably good for certain constructs, they were very poor in the case of others. Such inconsistencies have been found in previous studies as well. It would seem, therefore, that future research relating to the use of attribute data for predicting aptitude requirements of

jobs might well be focused on the identification of the particular attributes for which such predictions can be made with reasonable validity.

6. In summary, although previous research with the use of the PAQ as the basis for establishing aptitude requirements for jobs within the job component validity framework has dealt exclusively with test data from the GATB tests, the results of this study indicate quite clearly that such data can also be used in the establishment of aptitude requirements in terms of commercial tests that presumably measure the same constructs.

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